ENGINEERING NEWS.

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GEO. H. FROST, PROPRIETOR.

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Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

GEO. H. FROST,
Tribune Building, N. Y. City.

1881.

As compared with its immediate predecessors, the year that has just closed has been a prosperous one for the engineering profession, and those who may be considered as engaged in the engineering trades. Since 1872 there has been no such activity in railway construction as in 1880; city improvements have been recommenced where municipal impecuniosity previously had stopped them; the National Government expended a large sum of money in river and harbor improvements; and the immense emigration to our shores, with other causes, brought better times to the land surveyors, who had begun to lose all hope of improvement in their branch of the profession. Notwithstanding there were any number of new projects started and old ones kept in progress, giving employment to an army of engineers, yet there still were complaints of want of profitable employment by many in the profession. We do not see how this can be very much improved in the future. There are a considerable number of engineers who cannot, of necessity, accept subordinate positions with the correspondingly inadequate pay and meagre prospect of improvement; there are engineers who, having a barely sufficient income for their personal wants, prefer to accept the situation and to enjoy the comforts and privileges that a city affords, than to endure the hardships of active professional life in the field; there are engineers who are anchored by family ties to an unprofitable location and who dare not take the risk of removal; there are others who have been stranded by age, others by often-proved incapacity, or by bodily ailment; there are foreigners just landed on our shores, ignorant of the language and of our methods of work, and there are occasional fledglings, with the ink of their theses hardly dry, who complain of the unappreciation of their superior talents; to some among all these classes the times are not yet prosperous, and it is doubtful if they ever will be to all of them again. But to the great bulk of the profession it may be truly said that the "good times" have come, and that they are daily growing better. Railway building always has been, and it must continue to be, the principal and most profitable field for civil engineers; the prospects for the present year are most encouraging, and it seems as if there were enough new projects being advertised every week in the daily and class journals to warrant the assumption that the services of every engineer of ability would be wanted during the coming season. The men who fail or complain in 1881 will be almost certain to always fail and complain, for if we are not entering on a decade of most remarkable engineering enterprises, then all the "signs of the times" are most fallacious. It is not necessary to enumerate the many and important works that are already projected, nor to specify in what portions of the habitable globe they are located. They are the current news of the day; and an article, elsewhere in this journal, outlines the activity prevailing in foreign lands.

The men who have the courage, energy and financial means to go to Texas, Mexico, Colorado, or any of the regions where the most activity is now prevailing, and who *go to stay*, will succeed, if they have the qualifications for success in them; but if they prefer to stay comfortably at home in an Eastern city and wait "for something to turn up" they will miss the best opportunity of their lives. Civil engineers should take the lead in promoting new enterprises, in carrying them through to completion, and subsequently in operating them, and this they can do if they push their claims with sufficient intelligence, energy and pertinacity. The young engineer has no permanent home, and he should religiously keep himself clear of all "incumbrances" of a domestic nature. Travel is his opportunity and a large portion of his subsequent stock in trade; eventually he will become identified with an enterprise that will give him a permanent abiding-place and a competency, but these are not to be expected except as the reward of many years of honest effort and wide experience.

ENGINEERING NEWS in the coming year, even more than in the past, will endeavor to present to its now large and daily increasing list of readers a weekly record of engineering works, projected or in process of construction, on this continent, and as far as possible in other countries. Its primary aim is to assist its patrons to *make money*, and as *we know* we have heretofore succeeded in this more largely than our readers may suspect, so we expect henceforth to render even greater assistance. We thank our patrons—subscribers and advertisers—for their past generous support, and hoping to merit it still more henceforth, we wish them all a very prosperous future.

THE PANAMA CANAL.

The Panama Canal project would seem to have entered on that important preliminary phase to all industrial undertakings—having the capital stock subscribed. The scheme of cutting the isthmus is one of such engineering difficulties and such momentous international importance that it has naturally called forth very divergent and very extreme views. The newspapers of the civilized world are full of comments, adverse opinions without reasons, or mere puffery, of an undertaking which, although practical and beneficial in itself, is hardly likely to prove an immediate or very certain source of revenue to the stockholders.

The views which the engineering world would take of the canal would be simply from a professional standpoint. M. de Lesseps, if not, perhaps, the eminent engineer which he is generally supposed to be, yet has done much to elevate the calling in the popular mind. Engineers, too, are justly proud of his reputation, and believe that the great works of the ancients have been surpassed in the cutting of the Suez Canal, both in respect of size and utility. M. de Lesseps, as a diplomatist (as he prefers to be regarded), or as a financial agent, is quite another person, and in that capacity, will be fully "attended to" by another section of the press.

Now that active work will soon be begun, it is unfortunate that more minute details of the survey have not been given. The *devise* or rough estimate of M. de Lesseps has not been adhered to—figures have been cut down enormously. As there is little "fringe" in canal cutting, this great reduction must apply to what we consider the main work. The first estimate of 843,000,000 francs has been reduced to 580,000,000 francs—the contractors have even brought it to the fine point of 482,000,000 francs. The estimate of De Lesseps' commission for excavations was 517,874,963 francs; afterwards increased by M. de Lesseps himself to 570,000,000 francs. Yet the contractors place the cost at 429,874,899 francs. Both parties cannot be right. The safeguards against floods have, in like manner, been subjected to fearful cutting down, viz., from 75,000,000 to 20,000,000 francs, while the dam of the Chagres River is to cost only 10,000,000 francs, instead of 100,000,000 francs.

It is a pity that more harmony does not prevail in such a work as the joining of the Atlantic and Pacific oceans. Instead of one unanimously adopted plan, we have actually four—two tide-level canals and two ship railroads. In the present state of the world's commerce it would be impossible for more than one of those works to pay. Yet political reasons—ill or well founded—and financial and other matters are brought into the discussion of a purely engineering subject, which should be judged on engineering merits alone. This partiality or bias is shown by De Lesseps' oppo-

nents as well as by himself. Captain Phelps, in enumerating the advantages of the Nicaragua route, states that it would save 500 miles as compared with that of Panama. But this would only be in so far as California is concerned, for he forgets to deduct the shorter way of the rival scheme for South America, Australia, etc. The opposition to De Lesseps should come only from experienced and unprejudiced men, but while one party endeavors to strengthen itself with the name of General Grant, the other thinks that an intending ex-Secretary of the United States Navy would be the proper person to counterbalance any undue effulgence from the opposition.

The manner in which the Paris market has been prepared for the De Lesseps' canal stock is open to grave objection. M. de Lesseps may consider that the end justifies the means, but the end for the stockholders is so uncertain that many of the Suez stockholders, who were entitled to a premium on purchasing Panama stock, actually preferred to loan their stock to outsiders.

There is another very important matter which has been altogether ignored in the estimate of cost—the large sums for surveys, machinery, interest, etc. The sum of 530 millions is merely for excavation. These expenses are in themselves enormous, and have been estimated as follows:

	Francs.
Lieutenant Wyse's privileges	10,000,000
To bankers and United States Colombia	63,000,000
For Panama Railroad stock	70,000,000
Loss of 6 per cent. on construction, outlay on 73,000,000 francs, and other outlays during eight years of building	283,000,000
	426,000,000

Thus the total cost of the canal would be in any way double the contractors' estimate. It must be admitted, however, that M. Couvreux, who also made the survey, has earned a reputation as a skillful and daring engineer by his improvements of the port of Antwerp (destined soon to equal, if not eclipse, that of Liverpool), and by the regulation of the navigation of the Danube, carried on under his charge.

The advantages accruing to commerce from an isthmian canal are—at least in the present condition of the world's transit trade—greatly exaggerated. Taking the point of departure of English, French, Norwegian and German vessels, as from the English Channel, and comparing the distances by the Panama and Suez routes, or by the capes, we find the following interesting figures:

	Panama.	Suez.	Cape Horn.	Cape of Good Hope.
	miles.	miles.	miles.	miles.
New York to Calcutta	14,750	9,897	18,650	12,500
" to Melbourne	10,260	13,162	12,900	15,030
" to Hong Kong	11,238	11,706	17,680	14,701
" to Valparaiso	4,700	.....	8,720	.....
" to San Francisco	5,280	.....	13,610	.....
Liverpool to Calcutta	17,300	7,966	18,600	11,790
" to Melbourne	12,869	11,231	13,097	12,598
" to Hong Kong	14,290	9,865	17,877	13,640
" to Valparaiso	7,340	.....	8,017	.....
" to San Francisco	7,709	.....	13,710	.....

The mass of the English and Oriental trade would follow present routes, either on account of a saving of time or money, or, of both. Still, it is very likely that the trade of North America with South America, and especially with the thickly populated Oriental countries will increase enormously within the next few decades. The canal would have a potent effect in developing our Southern ports, especially Galveston, New Orleans and Mobile; the vast trans-Mississippi region would become one of the most thriving in the world, and new outlets would be opened for cotton, tobacco, sugar, etc., articles which the densely inhabited countries cannot afford to cultivate. With the opening of the canal a new railroad era would begin, numerous lines would be made from North America towards the isthmus, and from South America in the same direction. The commerce of the world would center in the United States. Our Atlantic ports would have the "start," in every sense of the word, over their European competitors, and there is no doubt but that they would know how to utilize and maintain it.

The prospects for the engineering profession would be of the most roseate hue. While we are desirous, however, of seeing the scheme of M. de Lesseps, or of any competent engineer, succeed, it would not be pleasant to the profession to see it made in any way an instrument for capturing shareholders. As matters now stand, all the canal engineers are as much at variance as Gil Blas and the opponent of the Don Sangrado system of medicine; and, this being so, engineers themselves, as well as the general public, have only to hear both sides patiently, and hope that the best man may win.

PERSONAL.

Philip D. Fisher is Chief Engineer of the Toledo, Delphos & Burlington narrow gauge.

Colonel John G. Barnard, of the Corps of Engineers, has been placed upon the retired list, by the President.

Walter Hughes, who discovered the Walleroo and Moonta copper mines in Australia, has been knighted by Queen Victoria, besides being the richest man in South Australia.

John Rowe, formerly Surveyor-General of Pennsylvania, and Speaker of the State House of Representatives, died on the 27th ult., at Greencastle, Franklin County, Pa.

Major B. B. McDonald, of Bucyrus, Ohio, Superintendent of the Bucyrus Machine-Works, contractor for gas-works of that city, and more recently contractor on the Atlantic & Lake Erie Railway, died in Bucyrus on the 23d ult.

Gen. O. M. Poe, U. S. Engineers, was in New Orleans on the 23d ult. Gen. Poe is on a special mission, his duty being to examine the lines of communication between Texas and New Mexico. He will go to San Antonio, Dallas, Laredo, San Felipe and other points.

H. W. Parkhurst has accepted the position of First Assistant Engineer on the construction of the Bismarck bridge, under George S. Morison, Chief Engineer, and was to leave Plattsmouth for Bismarck on Jan. 1, to make preparations for the commencement of vigorous operations as soon as the ice breaks up in the Missouri.

The incorporators named in Mr. Morton's bill to charter the "Maritime Canal Company" are Gen. Grant, Gov. Morgan, H. J. Jewett, Commodore Garrison, Frederick Billings, Riggs, the banker, Gen. Beale and Gov. Dennison. They are not men given to "fooling," but if they are going into an earnest rivalry with De Lesseps they have no time to lose.

Gen. E. L. Vielé, an engineer long connected with New York city improvements, tells this story: "When, in 1856, I first began to lay out the Central Park, an entire block at Sixty-fourth street, between Fifth and Madison avenues, was offered to me at $600 per lot. I tried in vain to get a capitalist who had plenty of money to see it in the same light as I did, but he declined to purchase it. Since that time, one single lot in this identical block has sold for $50,000, and the entire block averages to-day fully $30,000 for each lot."

Chas. C. Lund, C. E., died Dec. 4, at his home in Concord, N. H. He graduated at Dartmouth College, and practiced law for a time in Minnesota and at Concord, but of late years had given his attention exclusively to engineering.

Mr. L. was engaged on some of the earlier railroad surveys across the continent; was principal assistant engineer on the Concord Water-works, and afterward Chief Engineer of Leominster, Mass., W. W., and lately had attended to the city engineering of Concord. He had for a long time been the Chief Engineer of the Boston, Concord & Montreal R. R., and had superintended the construction of all its recent extensions, one of which, from Fabyan's to the base of Mt. Washington, is noted for having the heaviest grade on which traction engines are used. He was Chief Engineer of the Profile & Franconia Notch R. R., and acted as Superintendent during the season in which the road was in use. He had represented Concord in the house, in the last two legislatures, and was considered one of the most brilliant and popular citizens of that city. Few men had more or warmer friends, or deserved them better.

He was 48 years of age, and left a wife and two sons.

REMARKS ON HYDROSTATICS.

BY H. E. LICKS.
Written for Engineering News.

No. 3.—MISCELLANEOUS LUCUBRATIONS.

1. Some of the text-books state that the horizontal water-pressure against a submerged surface is equal to the weight of a prismatic volume of the fluid, whose base is the vertical projection of the surface, and height the depth of its center of gravity below the water level. This is true in general only for plane surfaces, and not for cylindrical or spherical surfaces. If, however, the head of water be so great that the pressure per square unit can be considered uniform over the whole surface, the theorem is entirely applicable.

2. The following are some of the most frequently used hydrostatic constants. For the weights of water per unit of volume we have:

0.0361 pounds = weight of a cubic inch,
8.34 pounds = weight of a gallon,
62.4 pounds = weight of a cubic foot;

and correspondingly in the metric system:

0.001 kilos = weight of a cubic centimeter,
1 kilo = weight of a liter,
1,000 kilos = weight of a cubic meter.

For the relation between the head of water and its pressure per square unit we have:

1 foot head gives 0.433 pounds per square inch,
1 lb. per sq. inch corresponds to 2.31 feet head;

and in metric measures:

1 meter head gives 0.1 kilos per square centimeter,
1 kilo per sq. centm. corresponds to 10 meters head.

3. By virtue of its fluidity and practical incompressibility, water, when confined, possesses the marvelous property of transmitting an applied pressure undiminished in intensity in all directions. Thus is rendered possible the great multiplication of power in the hydrostatic press and hydraulic jack. Nothing is more easy than to apparently increase, by the use of this principle, the pressure of water from 30 to 30,000 pounds per square inch. Imagine two pistons, one of ten and the other of ten hundred square inches area, connected by a common piston rod. Let these pistons fit water tight in two cylinders, each having a water tight space behind it. Let two pipes fitted with pressure gauges communicate with these spaces. Let the space behind the small piston be filled with water, and the pipe communicating with the large space be connected with the service pipe of the house. Let the interior arrangements of pistons and piston rods be carefully concealed from view. The spectators having now been admitted, the cock is turned and water allowed to enter the large space, where it acts upon the piston under a pressure, as shown by the gauge, of 30 pounds per square inch. The total pressure on the large piston is hence 30,000 pounds, and this is all transmitted through the piston-rod to the small piston. The pressure per square inch on the small piston is, therefore, 3,000 pounds, and this will be communicated to the water behind it and indicated on the gauge. The spectators, who

know nothing of the interior arrangements, gaze upon this result with astonishment, and imagine perhaps that the apparatus possesses some occult power to unloose the molecular forces of the water, and that it is the germ of a new and wonderful motor destined to revolutionize the mechanical world.

4. The value 62.5 or 62.4, usually taken as the number of pounds in a cubic foot of water, is only an average value, and is subject to an uncertainty in its third significant figure due to changes of temperature and other causes. Hence in any calculation involving these average values only three significant figures should be retained, and it should be remembered that the third is liable to an uncertainty of about one unit. To retain more figures is worse than useless. For example, consider the following problem given in a standard hydrostatic book: Required the normal pressure on a rectangle, whose sides are 18 and 3 feet, when immersed in water so that its shorter side is in contact with the surface and its plane inclined to the horizon at an angle of 68 degrees. The author solves the problem, using 62.5 lbs. for the weight of a cubic foot of water, and finds 28,163.0925 lbs. for the normal pressure. Here the decimals are superfluous and ridiculous, the 3 and 6 are unnecessary, and all that can be fairly stated is that the pressure is *about* 28,200 pounds. It might, indeed, be well to show the uncertainty of the result, to say the pressure lies between 28,100 and 28,300 pounds, but even these limits are narrow.

5. From the temperature of maximum density to the boiling point of water is twenty-four times as far as from the freezing point to the maximum density point. Water, when changing into ice, expands one-twelfth of its volume; when changing into steam under common atmospheric pressure it expands about sixteen hundred times. From the freezing point to the maximum density temperature water contracts about one eighth-thousandth of its volume; from the maximum density point to the boiling point it expands one forty-eighth of its volume. Whence and wherefore arise these peculiar numbers, 12, 24, 48, 1,600, 8,000? Do they perhaps point toward laws connecting the properties of water with those of its constituent elements hydrogen and oxygen? Two volumes of hydrogen and one of oxygen condense to make two volumes of water vapor, and their relative combining weights are 2 and 16. There can be, no doubt, that such laws exist, and perhaps the day may come when a more perfect chemistry may be able to discover them. Such a chemistry will be highly mathematical. A complex differential equation will perhaps express the properties and energies of the element hydrogen and another those of oxygen, and their combination will produce a resulting algebraic formula, as long maybe as one's arm, but in it will be expressed the properties and energies of all the oxides of hydrogen, of which water is the simplest and most useful. That day is far hence, but when it comes the chemical mathematicians will know *whence* the properties of water arise. Yet even they shall fail to discover the why and the wherefore.

ENGINEERING MATTERS ABROAD.

[From Our Own Correspondent.]

PARIS, Dec. 16, 1880.

The super-abundance of capital in this country and in England, the low rate of interest, and the scarcity of good home investments, are having a great tendency to stimulate new engineering enterprises in the comparatively new countries. The railway age which, during its continuance in Europe, absorbed such an enormous capital, is by no means over, but the great lines of the future will undoubtedly lie in the other continents. But it would be a mistake to believe that railway building is going to slacken in Eastern Europe, or even in France. There are only 24,424 kilometers of railroads in this country at present, but when the plans of Freycinet are carried out, we shall have 40,000 kilometers, and it is estimated by competent writers that before many years France will possess not less than 100,000 kilometers of iron roads.

RAILWAY CONSTRUCTION IN EUROPE

is most active in Russia and Austro-Hungary. The former country has increased the length of its railroads from 11,270 kilometers in 1870, to 22,670 in 1878, and the latter country from 9,401 kilometers, to 18,391, in the same period. Italy has to make up for lost time; her 8,000 kilometers are altogether insufficient for the requirements of the country, but the abuses connected with the Lombard lines have make capitalists very timid. Spain is building some 160 kilometers per annum of new roads. Portugal will have 2,000 kilometers when the works now in progress are finished. England adds about 320 kilometers every year to her network. The movement which is now making in France, Germany and Austria to obtain state control or ownership of the railroads can hardly fail to give a new impetus to their extension. But there are other reasons which exert their influence—such as

INNOVATIONS IN RAILROAD CONSTRUCTION,

which make it possible to carry out works which existed formerly only in the dreams of our engineers. Thus we shall soon have a railroad up Mount Vesuvius. The upper section was inaugurated in last June. The mobility of the soil (lava, ashes, etc.) made it impossible to lay down two rails, as the necessary fixity of gauge could not be maintained. Each way is composed of a single rail, while the wheels of the wagon are vertical, and placed in the same axis at both ends somewhat like as in a bicycle. The traction is by two endless cables of hemp and steel. The motive drums are actuated by two machines of forty-five horse-power. The line is 800 meters in length. The incline varies from 400 to 680 millimeters per meter, or 32° 13′ (somewhat steeper than the average stairway). But the system used in this line is far from offering the same security as the line of Giessbach. The whole motive power is furnished by a fountain; the descending train having a supply of water so as to cause the ascension of the other. The inclination is here from 24 to 32 per cent.

The submergable railway at St. Malo, in Brittany, also offers some novelties in construction, although it is only 100 meters in length, and, therefore, the shortest in the world. Some 17,000,000 francs have been expended during the last 40 years in the harbor works, but the high-tides render St. Malo a most uncomfortable wet dock, while neap tides render it dry in one sense of the word. In the meantime, the inhabitants of St. Malo and St. Servan, which are separated by the bay, have been provided with a rolling bridge. It is simply a platform, surrounded by a balustrade, furnished with pent-houses and benches, and placed on four iron supports, which are themselves mounted on a truck which rolls over an iron way built transversely at the bottom of the passage. The vehicle is therefore aerial, terrestrial and maritime; in other words, it is a shuttle running between the two banks of the port.

THE ARLBERG RAILROAD.

This railroad, which is now definitively adopted by the Austrian government, will be a formidable competitor to the Saint Gothard, and of hardly less commercial importance. The country in the neighborhood of the lake of Constance is greatly isolated from the rest of Europe, so far as railway connection is concerned. When the Arlberg or Vorarl Mountain will be tunneled a saving of 300 kilometers for the export trade of Hungary will be effected, for most of the Swiss and South German freight concentrates at Bregenz, on the lake of Constance, or goes to Feldkirch direct for Switzerland, without touching German territory. It will form a great short cut for these rapidly growing ports, Trieste and Fiume, to South Germany, Switzerland and France, and thus make them competitors of Venice and Genoa. Trieste will gain as follows to the undermentioned places:

To	Kilometers less than by present route.
Feldkirch	284
Bregenz	210
Zurich	228
Basle	157
Strasburg	134

The tunneling of the Arlberg will take six years The Gothard tunnel will be completed in another two years, so that Venice and Genoa will have a start of four years for securing the Transalpine trade. But, yet another line will be necessary to secure Trieste—that to Villach, which will give another saving of 100 kilometers. There are some doubts, however, on the "beautiful blue Danube," whether the future great highway will not be *via* Calais and Salonica or Constantinople, and it is not unlikely that English trade may give it the preference and forsake Brindisi. The Arlberg will have to be tunneled in three places—through the Brenner, the Arlberg, and the Toblach. This would be unfavorable to large freight trade, and there would be advantages for shippers by using a route *via* Stuttgart, Munich and Vienna, or Pesth.

The capital required for the construction of the line is put down at 36,500,000 florins, but technical engineering difficulties may cause this estimate, as in the Saint Gothard case, to be greatly exceeded. The length of the rails is 136 kilometers, which may be divided into two sections—the valley portion, running from Innspruck to Landeck, and 65 kilometers of mountainous road from the last-named place to Bludenz. This latter part will offer some very interesting technical points. The minimum radii will be 250 meters, the maximum grades from 25 to 30 per cent. The tunneling will, however, constitute the main difficulty, and at what altitude the boring may be brought to by a judicious use of the cog system, is now a subject of discussion among engineers. The cog-rail, however, will not be suitable for heavy freight. The Andes line is as high as 4,770 meters, but, although the Arlberg has only 1,370 meters, its passage would be rendered peculiarly dangerous by the snow masses and avalanches. A pamphlet has been issued by an eminent Austrian engineer in favor of having two rails. The altitudes and lengths of the principal tunnels are as follows:

	Altitude. Meters.	Length. Meters.
Arlberg (east entrance)	1,302	10,270
Mont [Cenis	1,291	12,233
Gothard	1,145	14,920
Semmering	895	1,430

The greater altitude of the Arlberg tunnel naturally accounts for its lesser length, but it is not at all improbable that tunneling may be begun even higher up. It is expected to be open in 1887.

The St. Gothard, it is just announced, will be open on the 1st of July next. This fact has created some alarm here, and a petition in favor of the immediate piercing of the Simplon has been presented in the Chambers. M. Leon Renault wished the Government to allow a credit of fifty million francs to a company which is now in process of formation. Other members desired to know whether Mont Blanc would not offer greater advantages and less objections than have Simplon. The Chamber seemed to be in great doubts about the relative merits of the two mountains, and whether France had any interest in the next great "bore," for the matter was laid on the table. It may be said, however, that as long ago as 1873,

the members of the Left demanded a credit of 48,000,000 francs for tunneling the Simplon.

BRUNTON'S BORING MACHINE.

If all we hear of this new boring machine be true, tunneling will no longer offer many difficulties. From twelve to fifteen kilometers per diem can be bored through solid rocks. The average progress of the machines hitherto in use is now three meters; so then only 1,000 meters can be tunneled in the course of a year, unless where there are no hard rocks, when 2,000 meters may be made. A coal company near Marseilles—the Société des Charbonnages des Bouches-du-Rhône—are now tunneling a gallery with this machine. The said gallery will be fifteen kilometers in length, and is to connect their mines of lignite with a small seaport. 800 meters have been already cut out at the rate of 14.14 meters per day, or 0.60 meters per hour, with an expenditure of only 30 horse-power. This gives us quadruple the work of the machines hitherto in use, and would amount to 5,000 meters per annum. M. Biver thinks that we must calculate on 1.87 kilos. of mining powder for disintegrating a cubic meter of the lacustrine calcareous matters of the Fuvean basin. The results of the Brunton machine are: 0.60 meter depth, 2.20 meter diameter, 30 horse-power, excavation 2.28 cubic meter. This expenditure of 30 horse-power is equivalent to 8,100,000 kilogrammeters, or 3,550,000 kilogrammeters per cubic meter. The explosive force of the powder is also equal to 3,550,000 kilogrammeters. The machine costs seven times more than the powder, but as this is 2 fr. 50 cent. per kilo., and gives 270,000 kilogrammeters, which is also given by one horse-power, which, with coal at 0.025 fr. per kilo., is one hundred times cheaper; or, comparing machine with powder, the former does same work at one-seventh the cost. Dynamite has proved satisfactory in the Gothard Tunnel, but it does not afford the same safety as the machine.

THE RAILWAY FROM SENEGAL TO THE NIGER.

A railway to the "Mountains of the Moon" (in Africa) is one of the possibilities of the near future. In fact, the English are now studying the possibilities of an interior sea in Africa, while the French are speaking of a trans-Saharian railroad. But it will, doubtless, be news to most of your readers, that the Governor of Senegal has taken active steps for the construction of a railroad to the Niger. The indefinite country known as Soudan—of a length of 4,600 kilometers, and an average breadth of 650 kilometers—or a region five and a half times as large as that of France or Texas, may soon be put in rapid communication with the rest of the world. This is the country traveled by Mungo Park, by Denham, and more lately by Count Semellé. The population is estimated at 40 millions. The Niger forms the artery of the country, but the falls at Broussa, the terrible descent of 1000 kilometers long, and other difficulties make railways the only hope of bringing the country under the influence of civilization. Even the camels used by the French prospecting party took to their heels at the sight of the graceful giraffes.

There are three different routes spoken of for reaching the heart of Africa: from Tripoli, Algeria, or Senegal. The line from Algiers to the Niger would be 2,600 kilometers, but that from the growing port of Dakar is only 1,300 kilometers, and is now in course of execution. Six years are allowed for its completion. The line is divided into three sections: the first, from Dakar to St. Louis, of 260 kilometers; the second, of 580 kilometers, branches off at M'pal, and ends at Medine; the remaining 520 brings it to the Niger. Dakar has a good port, and is visited by the French packets from Bordeaux and the English steamers from Liverpool to Fernando Po. There will be very little earthworks, and the curves have a minimum radius of 800 meters; the grades are below 0.000 per meter except at the passage of the Thies. The viaduct at Leylear will be 120 meters in length. The cost of the first section is estimated at 16,234,000 francs. The second section has been only hastily surveyed. A credit of 8,582,751 francs has been voted for 1881-82 for the portion of the line between Medine and Befoulahé.

I shall have something to say in my next about the water supply here and the sewerage question, matters which can no longer be neglected by our municipality.

It is reported that the Chinese are about to construct a land line of telegraphs from Tsientsin to Pekin with a cable across the Yangtsze. The Great Northern Telegraph Company have offered to supply the material at cost price, and to work the line. One of their staff has already surveyed the line down the Yellow River.

Marshall, Marsh & Co., of Hongkew, have lately made a contract to supply the necessary machinery for the coal mines near Tsientsin, and to work them. The machinery consists of a portable engine, which can be worked at high pressure a pit-head frame, shafts, running gears, drums and baskets. Pumping gear will not be used.

A new survey is to be made by the Siamese government for a telegraph line. The line will be put up at once.

Railways are being rapidly built in Japan. Col. Crawford is pushing on the line which is to connect Otarunai with Sapporo at the rate of a mile a day, and as the distance is only seventy-five miles, it will soon be ready for traffic. Such rapidity of construction was previously unheard of in Japan.

It would seem that the telephone has been a real boon to the merchants of Gensan (Japan), who, we are told, were overworked by the process of communicating orally, which necessitated many a weary tramp. They now feel relieved.

The survey of the rail from Tokio to Jakasaki is completed, but it is yet uncertain whether the 15th National Bank (Japan) undertakes its construction.

THE WATER SUPPLY OF PARIS.

[Written for ENGINEERING NEWS]

BY WM. R. HUTTON, C.E., BALTIMORE, MD.

The ancient water supply of those parts of Paris which are distant from the Seine was derived from springs in the neighborhood of Belleville and the Pré St. Gervais, on the northeast of the city, which were first collected by the monks of St. Laurence and the Templars, in the 7th and 8th centuries, acquired in the 12th century by Philip Augustus, and by him extended into the city. At a later day they were made over to the city, which in 1457 rebuilt the aqueduct of Belleville—a great work for its day, a portion of which is still in use. On the south the springs of Rungis, Arcueil, etc., were brought in to supply the royal chateaux by the aqueduct of Arcueil, originally built by the Emperor Julian to bring water to the Palace of the Baths, and reconstructed by Maria de' Medici and Louis XIV.

In 1606 a pump, worked by water-power, was erected at Pont Henry IV. (now Pont Neuf) to supply the Louvre and the Tuileries, and in 1670 and '71 others were constructed by the city at Pont Notre Dame. The former was abandoned in 1812; the latter, with many alterations and reconstructions, were retained until 1854. The first steam pumps are due to the brothers Perier, machinists, who organized a stock company in 1776, under which pumps were erected at Chaillet and Gros Caillon, on opposite banks of the Seine, within the city, by which water was first distributed in 1782.

The enterprise, which cost $1,220,000, was not profitable, and the government finally (in 1789) became the owner of the works.

The distinction between the Royal Water-Works and the city supplies was abolished by the revolution, and an Imperial decree, in 1807, formally ceded the first named to the city.

The canal d'Ourcq is a navigation canal, by which the waters of the River Ourcq are brought to the basin of La Villette in Paris, from which the city is entitled to draw a daily supply of 105,572^{m3} (3,733,000 cubic feet—28,000,000 gallons). It was commenced in 1802, and finally completed about 1818, and its total cost has been about $12,000,000, including works, land and water rights up to 1873.

These were the sources of supply for Paris to 1854. The lower and more populous parts of the city were supplied from the canal d'Ourcq (Bassin de la Villette) which is at an elevation of 170.6′ (52m.) above the sea, the average of the streets being about 114.9′ (35 m.), the head was only 55.7′ (17 m.) which is entirely insufficient for the distribution of a large city. As a matter of fact, the effective head was observed to be less than half the actual height. The water is highly charged with the salts of lime, particularly the sulphates, and is rendered impure by the dejections of more than 1,500 sailors. It is, therefore, unfit for domestic use, but very proper by its abundance and elevation for monumental fountains and for washing the streets and sewers. In 1854, when the Prefect of Paris proposed to limit the canal water to public uses, and to seek other sources for a domestic supply, the project was warmly opposed. But the government would not yield, saying that it could no more withhold from its working classes good water than pure air or good bread. M. Belgrand was consulted. He observed that Paris lay in a basin of gypsum, which rendered impure all the spring water between Chateau Thierry and Melun. It would, therefore, be necessary to go to a great distance—to Normandy, Champagne, or Beauce, for a supply which should be clear, cool, and at least as free from salts as the normal water of the Seine. The existing sources furnished the following quantities:

	cu. m.	cu. ft.
Canal d'Ourcq (limited by size of mains to)	60,000	212,000
Seine by pumping	19,000	670,000
Aqu-duct of Arcueil (dry season)	300	10,600
Aqueduct of Belleville (dry season)	200	7,000
Artesian well of Grenelle	900	31,800
	80,400	or 2,839,600

In 1859-60 all the suburban towns (communes) lying within the new fortifications, 25 in number, with a population of 500,000 souls, were annexed to the city of Paris. The reorganization of the water supply was thereby rendered imperative, and the present system was immediately commenced.

The waters which are now supplied to Paris are for domestic use.

	cu. m.		cu. ft.
The Aqueduct of the Vanne furnishing	100,000	=	3,530,000
" " " " Dhuys "	20,000	=	706,000
A spring at St. Maur, pumped by water power into the reservoir of the Dhuys	5,000	=	141,200
Aqueduct of Arcueil	1,000	=	35,300
Artesian wells of Passy and Grenelle	6,000	=	211,800
	132,000	=	4,624,300
And for the public service:			
From the Seine by a series of steam pumping stations	88,000		3,107,000
From the Marne, pumped by water power	43,000		1,519,000
	cu. m.		cu. ft.
The Canal d'Ourcq	105,000		3,707,600
	236,000	=	8,333,000
Grand total	268,000	=	12,957,000

AQUEDUCT OF THE VANNE.

The Vanne is a small river which rises near Troyes on the margin of the chalk plains of Champagne, flows from east to west, and empties into the Yonne just above Sens. Its basin of 373 square miles (965 sq. kil.) is formed of 267 square

miles (665 sq. kil.) of permeable white chalk, and 116 square miles (300 sq. kil.) of tertiary soil, composed of red earth mixed with gravel, which covers the chalk and is drained by it. Hence it follows that the Vanne receives very little surface water, and is supplied almost entirely by springs, which maintain the marshes along its course, whose area amount to 5,373 acres, 8.38 square miles (2,173 hectares).

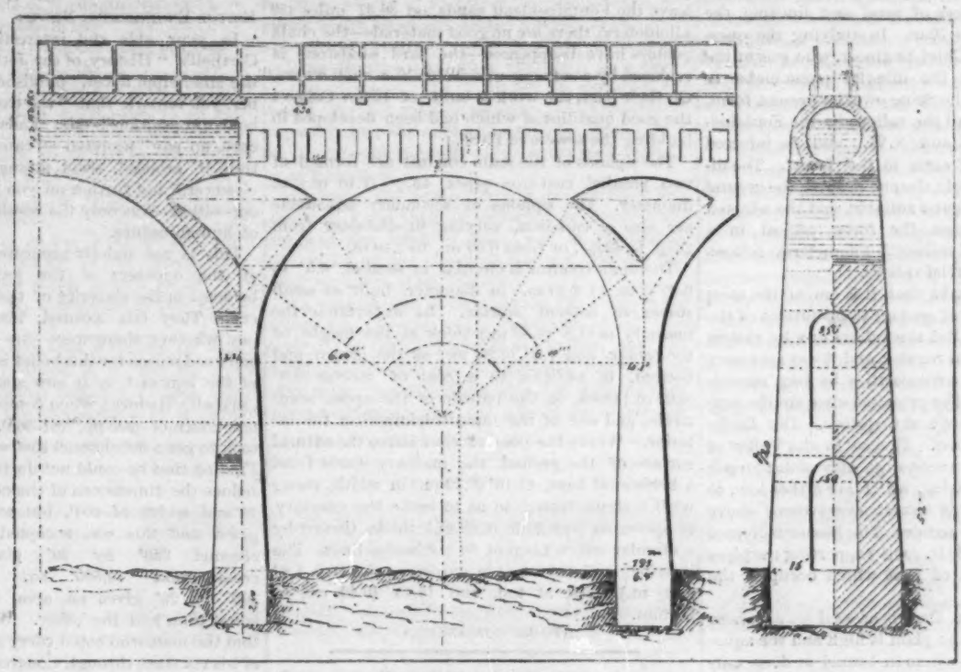
The City or Paris purchased eleven groups of springs, three of which are high enough to supply Paris by natural flow. The others are from 50 to 60 feet lower, and are raised by three pumping stations (which replace three mills), operated by the remaining water of the Vanne. These beautiful springs furnish a water of wonderful limpidity and coolness, and, being situated above the marshes, are not injured by their decaying vegetation. Besides these springs and the lands for the construction of the aqueduct, the city now owns 1,245 acres (504 hect.) of arable land, meadow and forest, and 19 mills.

The springs are brought by smaller pipes to a collecting aqueduct 5 58 (1.78 m.) in diameter, on the left bank of the Vanne, which it follows to Chigy, there crossing the marshes of the Vanne by a siphon, at an elevation of 356.9′ (108.75 m.) One of the springs, which has a fall of 65.6′ (20 m.) to the collector is utilized to raise river water to irrigate the fields previously watered by this spring. The collector extends on the right bank 4.25 miles, receiving on its way some of the lower springs. It is circular in section, 5.58′ (1.70 m.) in diameter on the left bank, and 5.90′ (1.80 m.) on the right bank, with a total length, including siphon, of 12.73 miles (20,368 m.). After leaving the marshes, it rests on the firm chalk slopes along the river.

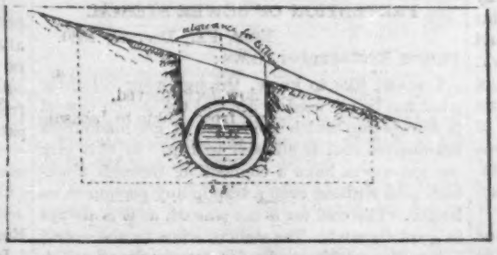
The main aqueduct begins at Theil and follows the slopes on the right bank of the Vanne and of the Yonne to Bourg de Pont. There it crosses that valley by a bold siphon 10,574′ (3,222 m.) long, partly carried on an arcade of 4,900′ (1,493 m.) in length.

The hillsides on the left bank of the Yonne are crossed by numerous secondary valleys in the chalk. The line passes from one valley to another by means of tunnels, crossing the deeper ones by siphons or arcades. The most important works are the tunnels of the Ville de St. Jacques, opened in a very hard marble, and the siphon of Loing, which is carried on 53 arches.

On the left bank of the Loing a serious difficulty was encountered. The elevated mass of fine



CONDUIT ON ARCHES.



CONDUIT IN EXCAVATION ON SIDELONG GROUND. *Outer Plastering is Outside of Line of Masonry.*

SECTION OF CONDUIT ON LOW GROUND.

AQUEDUCT OF THE VANNE.

sand, covered by the forest of Fontainebleau, appeared to be an insurmountable obstacle. This it was that caused the rejection of all the previous locations, which, to avoid it, had followed the slopes of the right bank, and beyond this mass of sand, dropped to the clay plains, which are much too low, causing a loss of head and limiting the height of delivery to 70 m. In studying the question, M. Belgrand, Chief Engineer, who was at the same time studying the diluvial phenomena to which the basin of the Seine owes its present form, had remarked that all the valleys in the Fontainebleau sands ran S.E. and N.W., and he inferred that it would be the same in the forest. The direction being precisely the one desired, the ground was examined and found suitable, and the adopted location runs through the forest almost in a straight line for 15.5 miles (25 kilometers), following one of these diluvial valleys.

M. Belgrand remarks that it is one of the most curious applications of geology to operations of the locating engineer. But the valleys dug by violent currents, are far from regular, and it was necessary to overcome these irregularities by long tunnels and high arcades. The principal ones are the tunnels of La Salamandre and Coquibée. The Ecolle is crossed by a siphon. Thence to the Valley of the Orge, the line traverses the clay plains (*argile à meulieres*) of the Seine, which are rather low, so that the aqueduct is almost everywhere above ground built on low arcades. The Essone is crossed by a siphon. Piles 50 ft. long supporting the pipes over the inside bed of peat which occupies the valley.

The Valley of the Orge is crossed by a siphon. Thence to Arcueil, the plain is high and the aqueduct almost every where in tunnel or deep cuttings, rendered very difficult by the presence of the sheet of water formerly collected in part by the aqueduct of Maria de Medici. At this point a small conduit was built under the main aqueduct to drain the spring water and facilitate the work. The last important work is the Aqueduct of Arcueil which rises 60′ higher than that of Maria de Medici, and 124.7′ (38 m.) above the bottom of the valley. Between Arcueil and Paris it was necessary to consolidate the ancient quarries (catacombs) under the works by means of masonry supports.

The slope of the main aqueduct from the Vanne to the Orge is 0.00013, and 0.0001 from the Orge to Paris. The head on the siphons is 0.0006.

The total length to the reservoir of Montrouge is 136,494 m. = 84.83 miles.

The supply furnished per day is 100,000 cu. m., 26,500,000 w. gallons.

It may be increased by additional purchases and works to 37,000,000 gallons.

The total cost was nearly $10,000,000.

The water was brought to Paris in June, 1874.

The total length of secondary conduits or collectors is as follows:

		Feet.
Of ovoid section—		
1.07 m. × 0.80 m. (3.5′ × 2.62′)		29,277
2.75 m. × 1.49 m. (5.75′ × 4.60′)		2,245
Of iron pipe, force main—		
0.60 m. (23⅝″) diameter		12,000
0.80 m. (31½″) "		7,000
1.10 m. (43 5-16″) "		1,720
		53,142
Of circular main collector—		
1.70 m. to 1.80 m. (5.6′ to 5.9′)		66,845
Of main aqueduct	447,948′	136,494.42
	568,034	173,085.82

	Mile.	Kilom.
Of which in cuttings there are	57.8	93
On arcades	9.05	16
In tunnels	25.48	41
Siphons	13.362	21.50

The total fall from the siphon of the Vanne is 94.35′ (28.75 m.). The section of the aqueduct is a circle 6.56′ (2 m.) in diameter from the siphon of the Vanne to the Orge, thence to Paris, 6.88′ (2.10 m.) in diameter.

Between the source and the boundaries of the departments of the Yonne, and Seine-et-Marne, the only materials of construction to be found in the country are the pebbles of the chalk, hard sandstones, and some quarries of limestone. The aqueduct is built of these three materials.

From the boundary of Seine-et-Marne until we leave the Fontainebleau sands, on 30.37 miles (50 kilometers), there are no good materials—the chalk pebbles have disappeared—the hard sandstone is replaced by a soft one unsuitable for such works. On their part, the work is built of béton Coignet the good qualities of which had been developed in building the sewers of Paris.

The siphons of the main conduit are formed of two parallel cast-iron pipes, 43 5/16″ (1.10 m.) in diameter. The siphons of secondary aqueducts are also of cast-iron, varying in diameter from 23⅝″ to 43 5/16″, or from 0.60 m., to 1.10 m.

The main conduit is circular in section, 6.5′ to 6.9′ (2 m. to 2.10 m.) in diameter, built of small stones in cement mortar. In excavation the masonry is 11.8″ (0.30 m.) thick at the height of the center, and 7.9″ (0.20 m.) at the crown and bottom, in addition to a coat of mortar 0.8″ (0.02 m.) thick on the outside of the upper semicircle, and one of the same thickness on the interior. Where the conduit rises above the natural surface of the ground, the masonry starts from a horizontal base, 11.16′ (3.40 m.) in width, rising with a slight batter, so as to make the masonry at springing line 27.2″ (0.69 m.) thick, thence by a circular curve tangent to the batter lines. The interior is circular as in cuttings, masonry 7.8″ (0.20 m.) thick at top, and 15.75″ (0.40 m.) at bottom.

(TO BE CONTINUED.)

CORRESPONDENCE.

PREVENTION OF SEWER STENCH.

ERIE, PA., Dec. 27, 1880.

EDITOR ENGINEERING NEWS:

I would like to know, through your columns, what means are used to prevent the stench caused in sewers into which the refuse of gas made from bituminous coal is allowed to run. In this city the gas-works have a connection through a six-inch pipe without even a trap in any portion of its length. The coal tar is not wasted, as it is always in good demand. The stench, when in the sewer, is very disagreable, and a dense vapor rises through every opening. W. W. BRIGDEN,
City Engineer.

SHARPEST ALLOWABLE RAILROAD CURVE. TURN-OUTS.

ENGINEERING DEPARTMENT, U. P. RY., Colorado & Cheyenne Divisions, DENVER, Col., Dec. 23, 1880.

EDITOR ENGINEERING NEWS:

Your correspondent, "S. E. R." seems to be in a peck of trouble with his *turn-outs*.

My ideas of the *possibilities* of sharp railroad curves have undergone a complete change since my connection with this road. I cannot answer "S. E. R.'s" first question, but will give him some examples of turn-outs from the "outside" of curves that we have in use.

At Beaver Brook, on the Colorado Central Railroad (Col. Div. of the U. P. Ry.) on the Mountain Div.—3-foot gauge—there is a switch turning out from the outside of a 28° *curve*, the siding itself being a 34° *curve*. This has been in use for some seven years.

On the same road, at Black Hawk, there is a switch turning out from the outside of a 30° *curve*, the siding itself being a 32° *curve*. This has been in use for some four years.

These switches are ordinary "stub" switches, with common connecting rods.

I can see no difficulty whatever in turning off from a 20° *curve*, if the *lead* is properly put in.

R. B. S.

THE MISSISSIPPI JETTIES.

ST. LOUIS, Dec. 21, 1880.

EDITOR ENGINEERING NEWS:

In your able and interesting review of Mr. Corthell's "History of the Jetties at the Mouth of the Mississippi River," published in your last number, you remark that "the excitement which this bold proposition"—Mr. Eads' well-known "no cure, no pay" proposal—"caused, and the opposition it aroused, seem strange to the impartial observer," and further on you remark that it—the opposition—was only the result of the contrariety of human nature.

This is not strictly accurate. Many, if not all, of the opposers of the jetty contract never believed in the sincerity of the "no cure, no pay" cry. They felt assured that there would be pay whether there were cure or not. That they had good reason for this belief is shown by the terms of the contract as it now stands (see pp. 368, 369, Corthell's History), when compared with the original contract (see pp. 261–265). Mr. Eads undertook to get a 30′ channel 350′ wide, for $5,250,000. Finding that he could not do this, he proposed to reduce the dimensions of the channel to a depth of 26′ and width of 200′, but *without reducing the price*, and this was accepted by Congress. A channel 350′ by 30′ gives an area of cross-section 10,500 sq. ft. A channel 200′ by 26′ gives an area 5,200 sq. ft. One is less than half the other. Will any one believe that the man who could carry such a modification of his contract through Congress would have failed to get "pay" without "cure"?

It seems well to invite attention to this, as it is probable that those who opposed the scheme will always be found opposed to schemes of "no cure, no pay." They will take that stand not on account of the "contrariety of human nature," but from motives which are disinterested and patriotic. OBSERVER.

HOWE TRUSS SPLICE.

RICHMOND, Ind., Dec. 15, 1880.

EDITOR ENGINEERING NEWS:

In response to C. E. W. D.'s communication to bridge engineers, in your issue of Dec. 4, I offer the following:

Of the two splices shown in the figures accompanying his communication, that shown in fig. 2 is the stronger; though *neither* of the splices he shows can be said to fill the requirements of a scientifically designed splice, as the following analysis shows:

The *splice* occurs in one of the two eight-inch pieces, these two forming the interior of the chord. The packing between those two members on the same side of the member spliced is about the same in both figures. Immediate attention will be directed to the member *spliced*.

Before attempting an analysis of these joints or splices, there must be known the relative resistance to strain of each of the different kinds or varieties of timber of which the members are composed, and the character of strain to which each is subject.

Without entering into a discussion of the relative merits of certain kinds of timber for chord pieces in bridge work, I assume the body of each of the four pieces made of a good quality of straight grained *white pine*, and the *clamp hooks* and *packing pieces* made of a good quality of straight-grained well-seasoned white oak.

The following is the *working* strain, sanctioned by practice and experiment, to which each may

be subject in the chords of a bridge truss, *with safety:*

White oak, in tension 1,200 pounds per sq. in.
" " in compression 700 " " " "
" " in shear, with the grain, 300 pounds per sq. in.

White pine, in tension 1,000 pounds per sq. in.
" " in compression 600 " " " "
" " in shear, with the grain or fiber of the wood, 100 pounds per sq. in.

As the capacity of the entire bridge is measured by its weakest member, so is the capacity of each chord measured by its weakest splice, and so is the capacity of that splice measured by *its* weakest part or member, and thus the weakest *details* in the weakest member of the structure limit the capacity of the structure.

Assuming 12 inches as the depth of the chord and one inch as the diameter of the clamp bolts, the weaker part of the splice shown in fig. 1 is easily discovered by an inspection of the following:

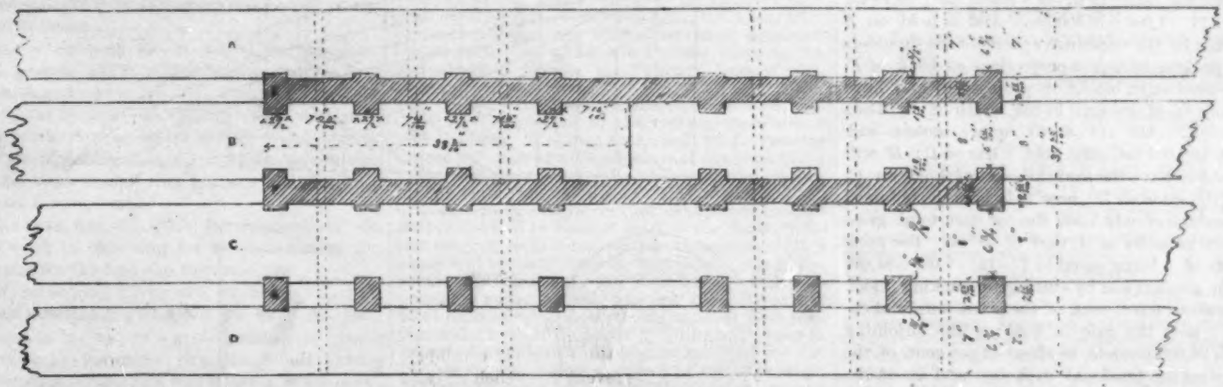
Commencing with the piece of timber in which the splice occurs (marked *A* on the fig.), and determining the resisting capacity of each detail in succession, I find the cross-section of *A* (where bolts pass through same) = $(8'' - 1\frac{1}{2}'') = 6\frac{1}{2}'' \times 12 = 78$ square inches; then deducting for bolt $6\frac{1}{2}$ square inches, there remains 71.5 square inches. This is in tension, therefore its maximum working capacity = 71.5 × 1,000 = 71,500 lbs. To find its capacity to resist compression there is at the shoulder $1\frac{1}{2}'' \times 12'' = 18$ square inches, and 18 × 600 = 10,800 lbs. = its capacity to resist compression or crushing. To find its capacity to resist shearing along the grain of the timber there is 21" × 12" = 252 square inches and 252 × 100 = 25,200 lbs. = its capacity to resist shearing; now passing to the weakest part of the hook clamp *E*, there is found $(1\frac{7}{8}'') = 1,875'' \times 12'' = 22.5$ sq. in. and 22.5 × 1,200 = 25,000 lbs. working capacity of the oak hook clamp to resist tension. As *it* has the same number of square inches under compression and shear as the pine piece just examined, and knowing that the capacity of oak to resist either of these strains is greater than that of pine, we have no occasion to search further for the weakest parts of the splice in this member of the chord. The resisting effect of the clamp bolts is not considered in comparing the relative efficiency of the different sections of timber in the splice, though it is important to have them placed in such a position in the splice as will produce the least cutting away effect that is to say, they should pass through the spliced member where it is not cut away for the hook of the clamp, and the thinnest portion of the clamp stick should be increased in thickness a sufficient amount to make up the area cut away by the bolts.

By a recapitulation there is shown the capacity of the pine stick in tension at splice = 71,500 lbs; in compression = 10,800 lbs.; in shear = 25,100 lbs.; and working capacity of oak hook clamp in tension = 25,000 lbs. Now, comparing these, it is seen at a glance that the compressive capacity limits the efficiency of the joint; that is to say, the joint is worth 10,800 lbs.; whereas the full section of the piece spliced is worth 8" × 12" = 96 sq. inch. × 1,000 = 96,000 lbs.; in other words, the splice is but about *one-ninth* as strong as the piece spliced. Now, this *cannot* be called a good joint.

To attain the maximum efficiency in a splice of this character, the difference or variation between the tensional capacity, the compressive capacity, and the shearing capacity, should be a *minimum*—the three should be equal each to each, or to a constant.

[In using the words tension, compression and shearing, I use them in reference to the *different parts* of the *joint*, or *splice*, *not* in relation to the action on the chord as a *single* member, for *that*, we know, is *all tension*.]

An examination of the splice in fig. 2 shows the following: $(8''-(1\frac{1}{2}'' \times 1\frac{1}{2}'')=8'')$ and $12''-1''$ (for bolt)$=11''$; then $5'' \times 11'' = 55$ sq. inches, and 55 + 1,000 = 55,000 = working tensional capacity of pine stick (marked *A'* on fig.). The working compressive capacity $= 1\frac{1}{2}'' \times 12'' \times 2 = 36$ sq. inches, an



36 600 = 21,600 lbs. This is at shoulders *E'* and *F*

The working shearing capacity = 21" × 12 × 2 = 504 sq. inches, and 504 × 100 = 50,400 lbs.

The working tensional capacity of the two oak clamp hooks $= (1\frac{7}{8}'' \times 2) = 3.75'' \times 12 = 45$ sq. inches and 45 × 1,200 = 54,000 lbs.

The tensional capacity of the whole stick = 8" × 12" = 96 × 1,000 = 96,000 lbs. as before.

Here again, the compressive capacity of the splice is found deficient, but not to the extent found in fig. 1, as the capacity of this splice is just *double* that first examined, in that the value of the splice was but 11 per cent. of the full tensional value of the stick; in this 22 per cent. is obtained; and yet *this cannot* be called a good splice. The greatest deficiency in each of these splices, is in *want of shoulder area;* though the packing of the several members of the chord is as deficient in bearing or shoulder area as is the splice; a brief examination will show this. The hold that the member *A* has upon *B* is measured by the compressive capacity of the shoulder at one end of each of the packing blocks *a b c*. The packing blocks are shown $2\frac{1}{4}''$ thick, and the space between *A* and *B* is shown $1\frac{3}{8}''$; this makes the shoulder $= \frac{5}{16}''$ deep, then $\frac{5}{16}'' \times 12 \times 3 = 10\frac{5}{16}$ sq. inches, and $10\frac{5}{16} + 600 = 6{,}480$ lbs.

Now the working tension capacity of the outside piece, or *B.*, is (at section where bolt passes through same) $= (7'' - \frac{5}{16}'') = 6\frac{7}{16}'' \times (12-1) = 11 = 73\frac{7}{16}$ square inches, and $73\frac{7}{16} \times 1{,}000 = 73{,}700$ lbs. The analysis of the splice in piece *A* showed that the tensional capacity of *A* = 71,500 lbs. Now, 6,480 lbs. is *too small* a proportion of the maximum strains allowed in either of the pieces *A* or *B*. There can never be a proper equalizing distribution of strain in these members with so frail a connection between them.

The same objection applies, with even more force, to the connection between *A* and *C*, for here the shoulder area is only $\frac{5}{16} \times 12 = 3\frac{5}{16}$ sq. in., and between *C* and *D* it applies, for here the shoulder area $= \frac{5}{16} \times 12 \times 2 = 7\frac{5}{16}$ sq. in. The packing in the other figure is open to the same objection.

Following I submit a plan of a splice, designed on scientific principles. It has borne the tests of experiment and practical work, and will stand the analysis of science. The following shows the relative capacity of its several parts. If "C. E. W. D." will follow through the calculations he will see the governing principles, and the methods to be used in designing splices of this character.

I have assumed the body of the members of the chord of the same material and dimensions as those shown in the two figures accompanying his communication, *i. e.*, the two outside pieces $7'' \times 12''$ and the two inside pieces $8'' \times 12''$ white pine; the clamp hooks and packing pieces seasoned white oak; the clamp bolts one inch in diameter. (In practice I would make the bolts smaller, as they should be depended upon only to keep the numbers in place laterally.)

The member spliced is shown on the plan as *B*. Assuming 12 inches as the depth of chord pieces as before, and determining by practical considerations the *number of hooks* or projections to be on the oak clamp pieces, and keeping in view the all important principle that tensional capacity should equal compressive capacity and equal shearing capacity, assuming that 30 per cent. (nearly) in width of the pine stick is cut away for the clamp hooks (I ascertained by trial, and made the capacities balance at a little less than 30 per cent. as will be seen), there will remain $5\frac{5}{16}$ inches. I have balanced it at $5\frac{44}{100}$ inches; then the working tensional capacity of the piece *B* is $5\frac{44}{100} \times 12 \times 1000 = 67{,}680$ lbs.

Now, as the compressive resistance per square inch for pine is taken at 600, $\frac{67680}{600} = 112\frac{80}{100}$ = the required number of square inches to be provided in the shoulders $= 112\frac{5}{16}$ square inches; dividing this by the depth of the chord, multiplied by the number of shoulders, there results the depth of each shoulder $= \frac{112.8}{96} = 1.18''$ Again, taking the total tensional capacity and dividing it by the shearing capacity per square inch $= (\frac{67680}{100})$ there results $676\frac{8}{16}$ square inches, and this divided by depth of chord multiplied by number of hooks or projections $= \frac{676.8}{96} = 7\frac{88}{100}$ inches, equal the *length* of each projection or hook in the pine member. Now, knowing the working shearing capacity of white oak to be 300 and that of pine 100, the length of the oak hooks or projections should be then but of the pine, or $\frac{7\frac{88}{100}}{3} = 2\frac{88}{100}$ inches. I have made them $2\frac{1}{2}$ inches in length.

Now, to determine the proper thickness to be

given the oak clamps at their thinnest part take the tensional capacity of the joint or splice, as thus far determined, as before, and divide it by the depth of chord and by the factor representing the tensional capacity of white oak; that is,

$$\frac{67680}{12 \times 1200} = \frac{35}{100} = 2\frac{35}{100} \text{ inches};$$

this equals the neat thickness; but, as the bolt passes through this section of the oak clamp, there must be added $\frac{1}{12}$ of $2\frac{35}{100}$ inches, = about $\frac{5}{16}$ inches, to the thickness, to compensate for the loss occasioned by the bolt; then $2\frac{35}{100} + \frac{50}{100} = 2\frac{85}{100}$ inches, equal the gross thickness of the oak clamp at its thinnest part; this also determines the space between the bodies of the members. Thus, the analysis shows this splice equal to 70 per cent. of the gross strength of the piece spliced. (Not counting or deducting for imperfections in workmanship.)

I consider it important that each member of the chord should be connected with that lying next it in such a manner that it can transmit to the other members 40 per cent. to 50 per cent. of the strain allowed upon it; this for perfect distribution of unequal strains. This object is effected through the medium of the packing between the chord pieces. Examining the plan I submit, the working tensional capacity of *A* is found=6¾ inches= 6.375″ × 12″ × 1,000=76,500 lbs. And its hold on *B* is limited by the crushing capacity of the shoulders of the packing blocks or projections on back of *E*. I have used eight blocks or projections and have cut away ⅝ of one inch in the width of *A*. Thus I have ⅝″=.625″ × 12 × 8=60 square inches, and 60 × 600=36,000 lbs.=the hold *A* has on *B*; *B* will be found to have the same amount of hold on *C*, and *C* the same on *D*; now this hold is obtained at a sacrifice of only 7,500 lbs. of the total gross tensional capacity of *A*; that is to say, the gross capacity of *A* being equal to 7″ × 12″ × 1,000=84,000 lbs., the amount lost by cutting for packing block equals about 9 per cent. of the gross tensional capacity; now the gain in hold on the adjoining piece is 36,000 pounds, or about 43 per cent. of the gross working tensional capacity, and so of the other connections between the different members of the chord.

Before dismissing the subject of the packing, assume that there is no more shoulder area in the packing in the plan I submit, than in that shown in the two figs. in "C. E. W. D.'s" communication, and the actual total working tension capacity of the weakest section of the entire chord at the splice will be as follows for the stronger of the two above referred to, *i. e.*, that shown in fig. 2:

	Pounds
For the stick *B'*, 6 7-10″ × (12″ − 1 =) 11″ × 1,000″ =	73,700
For the stick *D'*, 6 7-10″ × (12 − 1 =) 11″ × 1,000″ =	73,700
For the spliced stick,	21,000
For the stick *C'* — (8 — 6-10) = 7 4-10 × (12 — 1 =) 11 × 1,000 =	81,400
Total Capacity =	250,400

[This supposes that the packing blocks and the back of the clamp hooks are let into the pine sticks ⅛ inch each; this was the amount I made it from his figs.]

The total working capacity of the entire chord at its weakest section in the plan of splice, I submit, under the supposition made above, will show as follows:

	Pounds
For the piece *A*, 6 7-10″ × 12″ × 1,000 =	80,400
For the piece *D*, 6 7-10″ × 12″ × 1,000 =	80,400
For the piece spliced,	67,680
For the piece *C*, (8 — 6-10) = 7 4-10″ × 12″ × 1,000 =	88,800
Total capacity =	317,280
	250,400
Difference in the two	66,880

or nearly 27 per cent. stronger than the stronger of the two joints shown in "C. E. W. D.'s" communication.

Very Respectfully,

FRANK C. DORAN, Civil Engineer.

RELATIVE EFFICIENCY OF PROPELLER WHEELS.

FERRYSBURG, MICH., Dec. 18, 1880.

EDITOR ENGINEERING NEWS:

Having seen, during my inspection of steam vessels, many mistakes in regard to the proportions of propeller wheels, I send you a method for showing, *graphically*, the relative efficiency of propeller wheels having different "leads" or "pitches," as compared with their diameters; in other words, of propeller wheels having different "lead-angles."

The prevailing error that I have seen, is that of getting the lead, and consequently the lead-angle, too large for the diameter of the wheel, the owners forgetting or not not knowing that a large "angle" means a *large price for fuel*.

Let fig. 2 represent the projection of a propeller wheel, of diameter *AO*, say ten feet. Divide the radius of this wheel into any convenient number, say eight equal parts, and describe the eight concentric circles, 1, 2, 3, etc.

Also, in fig. 1, take *CO*, equal to the circumference of this wheel, and from *O*, set up *OA*, equal to *OA*, in fig. 2, and complete the parallelogram *ABCO*. Draw the diagonal *AC*. We shall then have in *CO* the developed circumference of the wheel; in *AO*, the "lead," one diameter, and in *AC*, the developed helix. Also, *ACO* is the lead-angle—in this case 11°36′.

Divide the parallelogram, *ABCO*, into eight equal parts by the full lines *ad*, *bc*, etc., to correspond with the eight concentric circles of fig. 2. Also divide each of these sub-parallelograms by the dotted lines 4,4′ 5,5′, etc., and number them 1, 2, 3, etc. These dotted lines in the parallelogram, correspond with the center lines of the consecutive rings in fig. 2. And if from the several points 1, 2, 3, etc., we draw lines to the point *A*, we shall have in these lines the developed helices corresponding to the center lines of the several consecutive rings of fig. 2. Also the angles made by these helices, with the base *CO*, are the lead-angles corresponding to the center lines of their respective helicoidal rings, whose projections are seen in fig. 2.

From the point *A*, with radius *AO*, sweep the quadrant of a circle; and from the intersection of each of the above helices, with this quadrantal arc, draw perpendiculars to *AO*. These perpendiculars will be the co-sines of the "angles" of their respective helices.

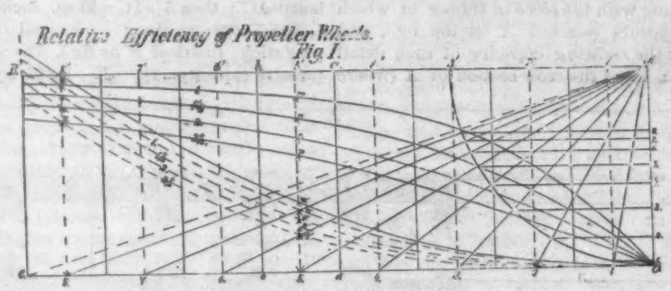
Amount of power utilized.—Pressure given to a fluid, by a solid in motion, is normal to the surface of the solid. Then if we represent by *AO*, fig. 1, the power that is applied by the machinery to any one of the helicoidal rings, whose projections are given in fig. 1, and set it up as a normal from the corresponding helix. We may project this normal on to any line that is parallel with the shaft, when we shall have the *measure of the power utilized*. Thus, for ring 5, fig. 2, make angle *A5O*, fig. 3, equal to *A5O*, fig. 1, and *M5* perpendicular to *A5* fig. 3, and make *M5* equal to *AO* of fig. 1. Also draw *N5* perpendicular to *O5*.

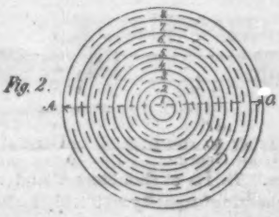
Project *M5* perpendicularly on to *N5*, and we shall have in *P5* the value of the power utilized, in terms of *N5* or *AO* as unity; and in *NP* that part of the power that is lost.

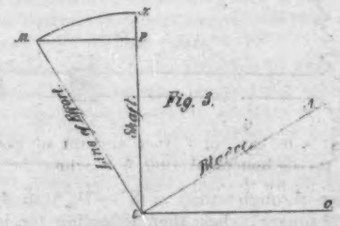
But *P5* is the co-sine of the lead-angle for that point, and *NP* is the versed-sine, that is to say:

The cosine of the lead-angle at any point in the radius of the wheel, is the measure of the power utilized at that point; while the versed-sine of the same angle is the measure of the power lost at that point.

We have in fig. 1. the co-sines constructed for eight points. Setting these up on their respective perpendiculars, and tracing a fair curve through their extremities, we have what may be called the *curve of power utilized*. Thus, in division 5, fig. 1, *m5*, is taken equal to co-sine 5. And so on the other perpendiculars, their corresponding co-sines are set up from the base *CO*, and through their extremities the curve *s1mO* is drawn.







In the same manner I have constructed the co-sines for wheels having respectively "pitches" of 1⅗, 2 and 2½ diameters, and set them up on their corresponding perpendiculars, and traced through their extremities the "utility" curves 1⅗, 2 and 2½.

Variable intensity of pressure. In consequence of the angular motion of the wheel, the velocity of any point in the radius of the wheel, varies as its distance from the center. But the circumferences of circles have the same ratio as their diameters, and the intensity of the pressure varies as the square of the velocity. *Hence the intensity of pressure, or percussion, at different points in the radius of the wheel, varies as the square of the corresponding circumference.*

But the distances of the points 1, 2, 3, etc., from *O*, fig. 1, represent the circumference of the rings 1, 2, 3, etc., of fig. 2. Whence, if we assume any line (as *AO*) as unity, to represent the intensity of pressure on the outer ring, 8, and from each of the points 1, 2, 3, etc., of fig. 1, set up ordinates proportioned to *AO*, as the square of their distance from *O*, we shall have points in the curve of a *parabola* with vertex at *O* the ordinate of which at *any* point will show the relative in-

tensity of pressure at that point. The full line *Om' 8'* is this curve, and the ordinates of it would show the useful work done, if all the power spent on the wheel were utilized. But this is not the case; and *to find the useful work done at any point, we must multiply the ordinates of the parabola (curve of intensity) into the ordinates of curve of co-sines (curve of work utilized).*

Thus, the ordinate, or rather external secant, *m'5* of the parabola, for ring 5, is 81 + 225 = .36. And the corresponding ordinate, 5 *m*, of the curve of co-sines is .87.

The product of these two decimals, is .36 × .87 = .31.

Setting up the ordinate $5n' = .31$, we have a point in the *curve of useful work*, *s1nO*. Other points in this curve are found in like manner. And in the same manner, too, are constructed the three other dotted curves, 1½, 2 and 2½, showing respectively the curves of useful work for wheels having respectively leads of 1½, 2 and 2½ diameters.

We have now the means of comparing wheels of different pitch, lead-angle, or lead, for any given diameter, with regard to the amount of useful work they develop from a given amount of power applied to them.

Thus, the external secant *m5* of the parabola, in the parallelogram corresponding to ring 5, is .36, which represents the total work done by that ring of the helicoid—including useful and non-useful work, for a wheel having *any angle of pitch*, while the distance, $n'5 = .31$, is the measure of useful work in that ring for a wheel having 1 diameter for the lead.

In the same manner, *q'5* is the measure of the useful work in that ring for a wheel having 2½ diameters for the lead—in this case, .20.

Now, measuring *n'5* by *m'5*, we have .31+.36= .86, and measuring *q'5* by *m'5* we have .20+.36= .55; that is to say, of a given amount of power applied to the helicoidal ring 5, a wheel having one diameter for the lead would utilize 86 per cent., while a wheel having two and one half diameters for the lead would utilize but 55 per cent.

We may further remark that the space, or area between the parabolic curve *8'm'O* and the base *CO*, represents the *total* work of the wheel—useful and non-useful—while the area between any one of the dotted curves and the base *CO* represents the *useful* work done by the corresponding wheel. Also the space, or area between any two of the dotted curves, represents the *falling off* of useful work between the corresponding wheels, due to an increase of ½ of a diameter in the lead.

From the above discussion we see, as on a map, the great waste of fuel attending the use of wheels of high lead. And we see the almost utter inutility of trying to get useful work from the middle half of the diameter of the wheel, particularly in those having high lead; for, by observing the spaces between the curves of co-sines, or those indicating the per cent. of power utilized, we see that in increasing the lead the part utilized falls off faster here than at the circumference of the wheel.

The high leads of 2 to 2½ diameter in, use 15 to 20 years ago, are fast disappearing, till now the lead of 1½ diameter is a very popular one. But if it were more generally known that even this lead is but a compromise between necessity and utility we should soon see (wherever possible to use them) wheels of *larger diameter*, and consequently of *smaller angle* for a given lead, resulting in a vastly greater amount of work done for the millions of money annually spent for fuel on steam vessels.

H. C. PEARSONS,
U. S. Insp. Steam Vessels.

Messrs. Fruin & Co., of St. Louis, have completed their contract in the Stillwater, Minn., Water-works, and the works have been accepted by the city. The water is brought from Lake McCusick a mile west of the city, and with a head of 150 feet. Direct pumping system. Cost of construction $175,000.

ENGINEERS' SOCIETIES.

AMERICAN INSTITUTE OF MINING ENGINEERS.

PRELIMINARY ANNOUNCEMENT OF THE ANNUAL MEETING, TO BE HELD IN PHILADELPHIA, BEGINNING TUESDAY EVENING, FEB. 15, 1881.

The council having appointed Philadelphia for the annual meeting of the Institute, the resident members have held a meeting and organized the following Local Committee of Arrangements:

Chairman, William Lorenz.

Secretary, John Birkinbine, 152 South Fourth street, Philadelphia.

Sub-Committees: On Finance—T. D. Rand, William Burnham, Israel W. Morris, Henry S. Drinker, H. T. Townsend, William Sellers, W. A. Ingham, J. A. Wilson, W. G. Neilson, J. W. Hoffman, E. Borda.

On Hotel Accommodations—Charles A. Ashburner, C. H. Roney, R. H. Saunders, G. R. Waite.

On Entertainments—Persifor Frazer, Franklin B. Gowen, J. P. Lesley, John Birkinbine, Percival Roberts, Jr., Henry S. Drinker, Henry Pettit, R. W. Davenport, J. S. Alexander, Chas. A. Brinley, G. A. Koenig.

On Railroad Fares and Excursions—Percival Roberts, Jr., William Lorenz, Israel W. Morris.

A subsequent notice will give the detailed programme of sessions, excursions, etc., but it may now be mentioned that the committee have arranged for an excursion which will include visits to the Midvale Steel Works, the Pencoyd Iron Works, Platinum Works, and (over the new viaduct) the new Public Buildings. A reception will be tendered by the resident to the visiting members at the Academy of Fine Arts, and Prof. Persifor Frazer will entertain the members at the Penn Club.

The subject of steel rails will again come prominently before the Institute at this meeting. Mr. C. P. Sandberg's paper on Rail Specifications and Rail Inspection in Europe, read at the Lake Superior meeting, will come up for discussion. (This paper will be distributed in pamphlet form in the course of a few days). Dr. C. B. Dudley will also present a paper at this meeting on the Wear of Steel Rails in relation to their Chemical Composition and Physical Properties. This latter paper is, in part, a supplement to the papers read by Dr. Dudley at the Lake George meeting in October, 1878, which have been productive of a most animated and instructive discussion, both in this country and in Europe. It is expected that this paper will be circulated in advance of the meeting, that members may be prepared to discuss it in connection with Mr. Sandberg's paper.

THOMAS M. DROWN, Secretary.

LAFAYETTE COLLEGE, Easton, Pa., Dec. 28, 1880.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The St. Gabriel, Canada, Water-works were completed on the 28th ult.

The Pittsburgh water pipes are still "bursting." There is still a scarcity of water in the smoky city.

The contractors on the Akron, Ohio, Water-works are making rapid progress toward the completion of their contract.

The City Council of Springfield, Ohio, are urging on the subject of water-works, and it is believed that work will commence before the end of the winter.

The reservoir which supplies Easton, Pa., with water sprung a leak on the 22d ult., and, as the hole was near the bottom of the basin, nearly the entire contents escaped. Where the water went to is a mystery, as it has not made its appearance on the surface anywhere in the vicinity. The basin is 180 feet square, and had 12 feet of water in it when the leak began. When the leakage stopped there was but 2 feet.

Resolved, That the City Engineer and Superintendent of the Water-works report estimate of expense and survey of the territory between the Eden Park reservoir and the Markley Farm, and said farm owned by the Water-works, with the view of obtaining information of the practicability of suppying the city with pure water economically from the Ohio River above the Little Miami River.—*Cincinnati Commercial, Dec. 28.*

WATER-WORKS WITHOUT COST.—By a recent decision in the United States Supreme Court the town of Litchfield, Ill., escapes payment for its $50,000 water-works, and the holders of its bonds issued for the works have to bear the cost, while the people of the town enjoy all the benefits of them. The facts are as follows: The Illinois State constitution contains an excellent provision forbidding counties, cities, towns, townships and school districts to incur any indebtedness over five per cent. upon the taxable valuation of property. Subsequently to the adoption of this constitution the legislature passed an act authorizing cities, towns and villages to construct water-works, and to issue bonds therefor. Under this act the town of Litchfield issued $50,000 bonds and built water-works with the proceeds. At the time this was done it owed a debt of $70,000, which was five per cent. on its taxable valuation ($1,500,000). Its limit of indebtedness had, therefore, been reached already, and it had no authority to issue the new loan of $50,000. The bonds were offered in New York, nevertheless, and easily sold. The town paid the interest on them for a time, but finally defaulted and refused to pay longer. The bondholders brought suit and the town pleaded in defence the constitutional prohibition which it had violated—that it had no authority to issue the bonds sued on, and they were, therefore, worthless. The lower court held this defense good, and the United States Supreme Court, to which the bondholders carried the case, affirms the decision. It holds that the constitutional prohibition is plain in its language and intent, and that its purpose was to prevent the contracting of just such obligations in excess of the five per cent. limit as this. The duty rests upon the bondholder to know not only the constitutional prohibition, but also when the debts of the municipal corporations have reached the five per cent. limit—even though this latter may involve the task of investigating the town's records to find out its bonded debt, its floating debt and its current obligations. Whether the court would hold, as it did in the case of the city of Louisiana, in this state, that the bondholders can sue and recover for moneys had and received, is a question on which the decision throws no light.—*St. Louis Republican.*

ELECTRICITY.

The Hoosac Tunnel is now successfully lighted by the electric light.

CINCINNATI, Dec. 30.—The books were opened to-day, and stock to the amount of $300,000 was subscribed in a few minutes for the formation of a company to introduce Maxim's electric light in Cincinnati, Covington and Newport.

STREETS, DRAINAGE, ETC.

The pumping-engine, for 11 hours in the inclement day of the test, shows the enormous and hitherto unattained duty of 128,398,809 pounds of water raised one foot high with 100 pounds of coal, under all the disadvantages that have been mentioned.

SPECIAL TELEGRAM.

BOSTON, Dec. 31.

EDITOR ENGINEERING NEWS.—Boston's Improved Sewerage Committee executed contract with successors to Henry Worthington & Co., for two twenty-five million sewerage pumping engines this noon.

If all the Chicago street improvements already ordered by the Council were to be carried out the coming year it would require an appropriation of nearly $5,000,000. The Board of Public Works will probably require $1,600,000 to carry on its work, owing to higher prices on material and the necessity for the building of many new sewers and intersections on streets to be improved or repaved. Last year the appropriation was about half the amount.

The pumping-engine connected with the Boston sewer-works, running from 27½ to 28 revolutions per minute, pumping under a head offully 50 feet, delivered through the stand-pipe, on the day of test, between 25,000,000 and 26,000,000 gallons of water in twenty-four hours. The steam pressure was 110 pounds per square inch; 200 pounds of Cumberland coal were weighed out every thirty minutes and put upon the brick-work in front of the boilers; whether used or not, the next half hour 200 pounds more were dumped. Including all kindling used, and putting the fuel at all that was weighed out, it will be 370 pounds an hour, and this makes the duty 117,300,000 foot pounds. The boilers in use are two of Mr. Corliss' upright tubular boilers, and were made for the job. They are temporarily set and are being run under these conditions.

The requirement of the specifications of the Boston committee on sewers was 43 feet maximum lift, and 35 feet average lift. The conditions under which the engines are running, are a lift of 50 per cent. more than the maximum requirements of the Boston committee, and nearly 50 per cent. above the average lift as stated, while the amount of water delivered is in excess of maximum requirements at regular speed, that it was designed to be run at. The result of one day's test, up to about 8 o'clock in the evening, was as follows: Cubic feet of water delivered per revolution, 84,958; weight per cubic foot, 62.37; revolutions per minute, average, 27.75, making pounds of water per revolution, 5,300; the average lift 50 feet; Cumberland coal used; from 9:15 a. m. to 3:15 p. m., 3,780 pounds had been used under the boilers, including all kindling.

BRIDGES.

The Clarke Bridge Co., of Baltimore, Md., are building an iron swing bridge and two turn-tables, for the Elizabeth City & Norfolk Railroad, and three iron spans for the Baltimore & Cumberland Valley Railroad.

RAILROADS.

The Southeastern Railway has commenced on its ice-bridge railway over the St. Lawrence at Montreal.

TORONTO, Ont., Dec. 30.—Largely attended meetings

were held in six towns to-day, to oppose the Canada Pacific Railway contract.

A great railway contest is likely soon to be inaugurated in New Hampshire. The question is on the business from Chicago to Boston.

Three corps of engineers are at work on the proposed line of the Chicago & Atlantic Railroad, which has its eastern terminus at Marion, Ohio.

Atchison, Topeka & Santa Fe stock has risen from $12 per share in 1878, to nearly $150. The original stockholders have netted fully $400 per share.

Contractors are widening Split Rock Tunnel on the C., R., I. & P. R. R., two miles east of La Salle, Ill. The tunnel is 200 feet long, and cut through solid sandstone.

It is stated that Mr. Hickson, General Manager of the G. T. R. of Canada, has completed the financial arrangements to enable the G. T. R. to be widened for a double track.

The subscription books of the Mexican National Railway Company closed Thursday afternoon. The total subscriptions were $12,000,000, $7,500,000 being what was wanted.

The Westinghouse Air-Brake Company's works, which are now situated in Pittsburgh, have become too contracted for the immense increase of business, and are to be removed to Allegheny City.

The project to build a railroad from New York along the west bank of the Hudson River to Albany, and thence westward along the south side of the Central & Hudson River road, is being revived.

There is no truth in the report that Gen. McClellan has declined to accept the Presidency of the New York Underground Railway. The General is now actively engaged in revising the estimates and contracts for building the road.

The Mexican government has fitted out a complete surveying expedition at its own expense, and put it under the command of Capt. Eads, to make a survey of the route proposed for his projected ship railway across the Isthmus of Tehuantepec.

C. C. Smith, railroad builder, has just been awarded the contract for twenty miles on the North Wisconsin, beginning ten miles from the present terminus of the line, the gap intervening not yet having been let. The east end of the contract is twenty miles from Bayfield. This work is said to be very heavy.

According to the Washington *Star*, the "net earnings of a sleeping-car, which costs $12,000, are about $1,000 per month, and the ordinary working life of one of them is from ten to twelve years. In other words, it pays for itself the first year, and after that makes about $100,000 clear profit for its owners, barring the cost of occasional slight repairs."

The Malayan peninsula is the last narrow neck of land which is found to obstruct the commerce of the world. A canal across this isthmus would save seven days on the trip from London to Hong Kong, which now occupies 35 for mails and 40 to 50 for tea cargoes. A short sum in arithmetic is all that is needed to show how much would be saved on every cargo of tea and silk by such a canal, and a company is forming in London to dig it. After this canal is well started, the Panama canal partly dug, the English Channel tunnel begun, little trifles like the Cape Cod and Florida ship canals under way, a railroad pushed into the desert of Sahara, another built down the Euphrates valley, the Canadian Pacific and the Mexican railroad system pretty well laid out and spiked down, the world in general will be ready for about the biggest panic even this century has seen. Peace has her destructive victories no less than war.—*Springfield Republican.*

The Bucyrus Foundry and Manufacturing Company (Ohio Central Railroad machine shops) has been incorporated at Columbus, with a capital stock of $100,000.

An Englishman named George Bailey was the pioneer in printing railroad tickets by wholesale. He began business in Buffalo in 1869, and making it a specialty, soon secured the patronage of nearly every railroad in his section. He employed men of wide experience in mixing the disagreeable colors and arranging the ill-suited type; he made honesty a passport to employment in his establishment; guaranteed that none of the tickets would be stolen, and assured the railroad companies against all possible losses by peculations while the tickets were still in his hands. The result was that he was extraordinarily successful, and the house in Buffalo is now looked upon as the greatest of its kind in the country. Rand, McNally & Co., of Chicago, were early rivals of Bailey, and built up a large patronage in the west, and lately a Boston firm have made successful bids for the New England printing.

SOME CANADA PACIFIC RAILWAY CONTRACTS.—The contract with the Toronto Bridge Company, for the construction of bridges over the two outlets of the Lake of the Woods, shows the total amount of the contract to have been $50,523. The contract with the same company for the construction of their bridges over the Pembina branch amounted to $13,925.

The contract of the 20th May last with the Northwest Transportation Company to transport steel rails from Montreal to Emerson and to Fort William, for the Canadian Pacific Railway, shows that the rate to Emerson was $14 50 per ton, and to Fort William $5 per ton.

The contract with Pillow, Hersey & Co., of date 10th August, 1880, to supply 100 tons of spikes for the C. P. R., shows the amount paid to have been $59 per ton.

On Sept. 12 a contract was entered into with Cooper, Fairman & Co. for supplying a similar quantity at $53.20 per ton.

On the 17th of July last a contract was entered into with William Stubbs, of Ottawa, for wire fencing, the price was $43,500, and the contract is to be finished by the 1st of July, 1881.

A similar contract was entered into with Messrs. Skead & Haycock, the price and time of completion being the same.

RIVERS AND HARBORS.

The successor of Capt. Ramsay, who has been detached from the torpedo station at Newport, will probably be Capt. T. O. Selfridge, who had charge of the survey of the Isthmus of Darien.

To the Editor of The World :

SIR.—The combinations are all made on the Robbin's Reef scheme, and it will be shoved with redoubled vigor at the incoming of the Legislature. Look out for a *coup d'état*. Yours, G. R. M.

NEW YORK, Dec. 28, 1880.

Mr. Ellis, of Louisiana, has introduced a bill into the national house, providing that there shall be appointed a special commission, of not less than three nor more than five engineers, to examine and report plans for the permanent improvement of the mouth of the Red River, and the removal of the bar at the falls above Alexandria. The bill calls for an appropriation of $400,000.

The engineer corps has made a report upon the contemplated improvement of the Youghiogheny River between West Newton and Keysport. The officer who examined the river recommends the construction of a large dam to give slack-water navigation. He estimates the cost of the improvement to be $230,000. Congressman Wise hopes to get an appropriation of $25,000 this session to begin the work.

CANALS.

General King, Chairman of the House Special Interoceanic Canal Committee, expects immediately after the recess to report the bill of incorporation of the Nicaraguan Canal Company, and intends at that time to call up the Monroe Doctrine resolution reported from his committee last session, and ask that an evening be set apart for the consideration of the two matters.

NEW PROJECTS.

Troy, N. Y., is to have a new $40,000 County House.

The British Post-office Department has ordered 20,000 telephones.

The Colorado & Western Railroad, capital $100,000, was incorporated on the 20th. ult.

The citizens of Rome, N. Y., are making efforts to have a penitentiary located in that city.

A company has been formed in Cincinnati to construct an elevated railway along the Miami Canal.

Bids for the construction of the Bergen Tunnel on the N. Y., O. & W. Ry., are called for by the company.

The Railway Commissioners of Massachusetts have refused to grant locations for elevated railroads in that State.

Messrs. Woerishoffer & Co., 54 Exchange Place, of this city, are the bankers of the Palmer-Sullivan Mexican Railroad Concession.

Jas. A. Ekin, Dy. Q. M. G., U. S. Army, at Jeffersonville, Ind., advertises for fifty parlor army heaters, proposals to be opened Jan. 21, 1881.

The Chicago & Northwestern Company seem to be in earnest about building a line from Geneva to connect at Waukesha with their new Madison line.

J. J. Hagerman, President of the Menominee Mining Co., has contracted to deliver 250,000 tons of iron from the company's mines next season, at $8 per ton.

The trustees of Cornell University at Ithaca, N. Y., have appropriated $100,000 for building and other improvements, to be commenced as soon as possible.

The Illinois Central Railroad has paid into the State Treasury, for the six months ending Oct. 31, $202,561, being 7 per cent. of its gross earnings for that time.

A new company, with capital of $100,000 is organizing to build a large dry dock on the North Branch of Chicago River. Particulars are not yet ready for publication.

In consequence of the feud between the P. R. R. and the B. & O. R. R., there is a possibility of the latter company building a new line from Philadelphia to Baltimore.

A narrow-gauge railroad is to be built from Chattanooga, Tenn., to the top of Lookout Mountain, and a hotel to accommodate 1,000 guests will be built on the mountain.

The survey of a railway from Cedar Rapids, Ia., to Rochester, Minn., thence to St. Paul, was commenced last week by two parties, one from Cedar Rapids, the other from Rochester.

Frederick Billings, President of the N. P. R.R., gives assurance that work on the Wisconsin Division of that road will be commenced this winter, just as soon as the final survey, now being made, is completed.

Messrs. Lagru & Levalle have arrived at Montreal from France, and intend erecting five beet root sugar factories in the province, the first of which will be at Berthier, and will turn out 2,250,000 pounds of sugar annually.

John Newell, General Manager of the Lake Shore & Michigan Southern Railroad, advertises that he will let, about Jan. 1, some very desirable winter work, grading between La Porte and Chesterton, Ind. Address Chief Engineer L. H. Clarke, Van Buren street station, Chicago.

Articles incorporating the Salamanca & Warren Railroad Company have been filed. The capital is fixed at $230,000. The road is to run from Salamanca to a point where the Allegheny crosses the line between this state and Pennsylvania.

The completion of the plans for the new La Salle County Court House, at Ottawa, Ill., has been awarded to Architect Beers, of Chicago. The structure will cost $100,000, and work is to commence as soon as the weather will permit.

The contract for the new steamer for the Old Colony Steamboat Company, which has been awarded to John Roach & Son of New York, is signed. The boat will cost nearly $1,000,000, and will be larger than either the Bristol or the Providence.

The St. Louis *Republican* says:

"It seems to be a settled fact that the Texas & St. Louis narrow-gauge railroad, which is now in operation for a considerable distance in the Lone Star state, will be extended from Corsicana to Waco.

NEW YORK, Dec. 28, 1880. At a conference between W. H. Vanderbilt and his general manager a few days since, it was decided to lay a second track of the Lake Shore & Michigan Southern railway from Chicago to Laporte, Ind., and contracts will be awarded immediately for the construction of the additional grade.

It is proposed to change the route of the Wheeling & Lake Erie Railroad. Thomas S. King, the Chief Engineer, C. R. Griggs, contractor, and the newly elected Board of Directors, were examining the proposed new route last week. A committee was appointed by the directors.

The legislature, having appropriated $7,000 to build a bridge from Isle La Motte to the main-land, and the town having been authorized to raise the rest of the necessary amount, the State now expects to receive the trade of the village, $15,000 or $20,000 worth, which heretofore has gone to New York State.

The Texas, Santa Fe & Northern Railroad, chartered under laws of New Mexico; capital $12,000,000; Charles J. Lowry, of New York, President; Narrow Gauge; route Santa Fe to Salt Lake City, with branch to Albuquerque; contracts for the San Juan Division will be let at once; office at Santa Fe, New Mexico.

The Queensland (Australia) government has passed an act authorizing the construction of the Trans-continental Railway, and a syndicate has already agreed to perform the work, on the condition of receiving, among certain other privileges, an area of 8,000 acres of land for each mile of railway constructed. The distance is about 1,117 miles, of which 800 are to be built. This will bring the southern colonies of Australia within 30 days of England.

Twelve men, under the supervision of D. C. Linsley, of Burlington, and W. E. Babbitt, of St. Albans, civil engineers of the Central Vermont line, making a final locating survey of the first line of railroad from Windsor to Hancock, N. H., have reached Lempster. They left Windsor two weeks ago, making a careful survey and locating the grade. They report that the heaviest grades found were 60 feet, and the line will be built at much less cost than was at first supposed. It is supposed that laborers will follow the surveyors in constructing the line at once.

An Omaha dispatch says: "Another bridge across the Missouri River at this city will probably be built and completed within one year. It will be for railroad trains, wagon and foot passengers. The company has been organized in New York, Frank Smith, a large Omaha property-owner, subscribing $50,000. The bridge will be a structure with draw for steamboats. The bridge, which is to be located north of the Union Pacific bridge, where the channel of the river has become fixed and permanent, is reported to be in the interest of the Chicago, St. Paul, Minneapolis & Omaha Railway and any Iowa railroads that may see fit to run into the city of Omaha."

A new railway line has been incorporated under the name of the Atlantic & Northwestern. It is the intention of its promoters to secure a shorter route to the seaboard from Sault Ste. Marie than the Intercolonial. The termini of the line will be a point on the Atlantic coast within the Dominion and a point on Lake Superior by way of Lake Michigan, Sherbrooke, Montreal, Ottawa and French River. The company is allowed by the charter to enter into arrangements with the Grand Trunk railroad for the use of Victoria Bridge or may create a new bridge between Windmill Point and the town of Lachine. The capital stock of the company is to be $5,000,000. The Provisional Directors are C. C. Colby, E. T. Brooks, Duncan McIntyre and G. G. Stevens. Capitalists are now being invited to take stock, and as soon as the capital has been subscribed the directors will call a meeting. The headquarters of the new company will be at Montreal. The act demands that work on the road shall be commenced within three years after the granting of the charter, and it must be completed within ten years.

BUILDINGS.

The number of permits granted in Brooklyn for new buildings this year, up to November 30, was 1,683. The estimated cost of the buildings is $6,415,804.

CHICAGO, Dec. 30.—A ballot taken by the Board of Trade on a proposition to move the Chamber of Commerce into a new building, to be erected south of the Grand Pacific Hotel, resulted in an overwhelming majority in favor of the proposition. The new building will not be ready for occupancy for nearly two years.